

A PMP model for the impact assessment of the Common Agricultural Policy reform 2014-2020 on the Italian tomato sector

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Jel Classification: C61, Q12, Q18

1. Introduction

On 12 October 2011 the European Commission presented a set of proposals for the Common Agricultural Policy (CAP) for the period 2014-2020. In particular, with proposal COM (2011) 625 which includes rules for direct payments to farmers, it introduced a new payment model replacing the current single payment scheme. The proposal supplies new instruments for reaching CAP objectives, which now give greater emphasis to the role of farmers in protecting the environment. The single payment is divided into several components, the main ones are the basic payment and the “green” payment. The “green” component, financed through 30% of total direct payments, remunerates environmental services and is based on three requirements: crop diversification, maintenance of permanent grassland and establishment of an ecological focus area. The proposal includes regionalisation and a convergence of direct payments, with the objective of reducing income disparities between farmers within Member States.

In Trilogue discussions, proposals for amendment have been put forward by the European Parliament and the

Abstract

The recent reform of the Common Agricultural Policy (CAP) establishes a new payment model mainly divided into a basic component and a greening component. This paper focuses on the effect of the convergence of direct payments and the three greening requirements: crop diversification, maintenance of permanent grassland and establishment of the ecological focus areas. The aim is to evaluate the effect of different proposals for the CAP Post-2013 on Italian farms, particularly on the processing tomato sector. Positive Mathematical Programming (PMP) is used to simulate different hypotheses of convergence and greening as proposed by the European Commission, the European Parliament and the Council of the EU. Commission proposals are shown to have different impacts compared to the other two. Commission proposals would significantly influence the regional production plan, leading to big reductions in cereal production and farm income. Parliament and Council two proposals would have lower impact on arable crop dynamics. In terms of land use, the tomato sector is relatively unaffected by the reform, but the payment convergence process significantly reduces tomato farm income.

Keywords: Cap reform, Greening, Positive mathematical programming, Processing tomato, Farmer behaviour.

Résumé

La récente réforme de la politique agricole commune (PAC) propose un nouveau modèle de paiement articulé autour d'une composante de base et d'une composante écologique (verdissement). Cet article propose une analyse des effets de la convergence des aides directes ainsi que des trois mesures de verdissement : diversification des cultures, maintien des prairies permanentes et création des surfaces d'intérêt écologique. L'objectif est d'évaluer l'effet des différentes propositions pour la PAC post-2013 sur les exploitations italiennes, avec une attention particulière pour le secteur de la tomate industrielle. À l'aide d'un modèle basé sur la programmation mathématique positive (PMP), différentes hypothèses de convergence et de verdissement sont simulées, compte tenu des propositions avancées par la Commission, le Parlement et le Conseil de l'UE. Les résultats montrent que la proposition de la Commission aurait des effets différents par rapport à celles du Parlement et du Conseil de l'UE, car elle influencerait d'une manière significative sur le plan de production régional, avec une réduction considérable de la production de céréales et du revenu agricole. Les deux autres propositions auraient, en revanche, un impact plus faible sur la dynamique des cultures arables. En termes de changement de l'affectation des sols, dans tous les scénarios envisagés, le secteur de la tomate s'avère être relativement peu touché par la réforme, mais le processus de convergence des aides réduit significativement le revenu des exploitations spécialisées dans cette culture.

Mots-clés: Réforme de la PAC, Greening, Programmation mathématique positive, Tomate industrielle, Comportement des agriculteurs.

Council of the EU, which attenuated the greening requirements, triggering a heated debate. The changes in the support system could impact on farmer behaviour and financial resources available to the agricultural system and, in particular, the processing tomato sector, where CAP payments currently account for a big share of producer income. Regionalisation and greening requirements could thus negatively affect the economic performance of processed tomato farms. This might lead farmers to modify organization of output and impact on availability of raw material for the entire supply chain.

The objective of this paper is to evaluate the effect of the Trilogue proposals for the CAP Post-2013 on Italian farms with particular emphasis on the processing tomato sector. It focuses on the effect of “convergence” and regionalisation of direct payments as well as greening. The three proposals

are assessed by a quantitative model based on Positive Mathematical Programming (PMP) (Howitt, 1995; Paris and Howitt, 1998). This methodology captures the economic information considered by farmers in taking production plan decisions, and makes it possible to predict their behaviour by varying the policy and market scenarios. The model is applied to farms in the Italian Farm Account-

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ancy Data Network (FADN) database which are located in the plain of Emilia Romagna, one of the main production areas of processing tomatoes in Italy. The assessment was carried out at farm level using the FADN weighting system in order to make the simulation results more consistent with the production structure of the area. The mathematical programming model yields results differentiated according to the various reform proposals in terms of changes in land use, variation in farm production and the effect on the main farm economic variables (gross saleable production, total variable costs, CAP payments and gross margin). It is also possible to compare the impact of the reform on tomato farms with the impact on other sectors.

This paper is organized as follows. Section 2 provides an overview of the processing tomato sector in Italy and trends during recent years. Section 3 presents the main contents of CAP reform 2014-2020, focusing on the new direct payment pattern: internal convergence and greening requirements as in the Trilogue proposals. Section 4 describes the PMP model used to assess the impact of the new CAP scenarios. Section 5 applies the model in order to evaluate the impacts of different policy scenarios resulting from the Trilogue proposals. Section 6 puts forward some conclusions.

2. The processing tomato sector

In Italy processing tomato is one of the most important products in the fruit and vegetable sector and agriculture as a whole. In 2011 it covered almost 85,000 hectares and the output reached over 5 million tons. Italy is the leading European producer of processing tomato and the third largest in the world, after California, which accounts for about one-third of world production, and China, which accounts for 18%. Italian processing tomato has a world share over 13%, and accounts for one third of the entire Mediterranean area production.

In Italy, processing tomato accounts for more than one fifth of the entire fruit and vegetable production, and covers more than 20% of the horticultural area (in open fields) and about 7% of the Italian fruit and vegetable area.

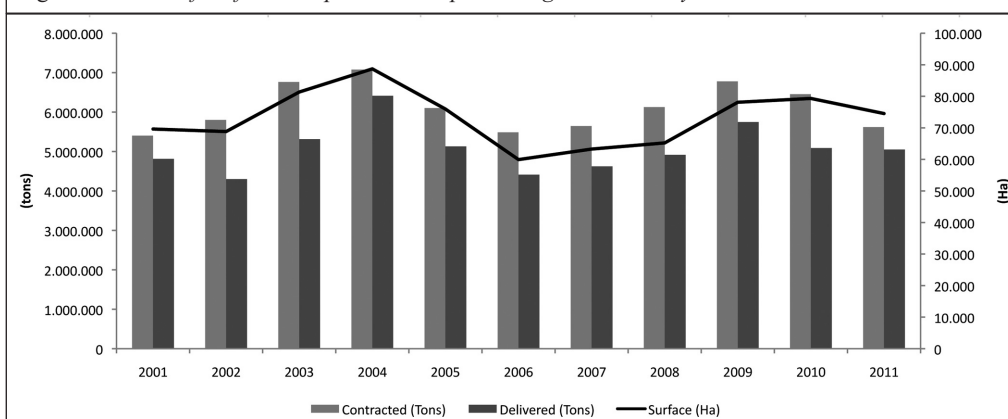
Over the years, processing tomato production has shown a fluctuating trend reflecting European and Italian agricultural policy, as well as climate and economic factors. In the last decade in particular, there was a significant drop in production in 2002 due to adverse weather conditions, which was followed by a two-year period of big increments resulting from an increase in the tomato area and an improvement of yields. The result was a peak of more than 5.8 million tons in 2004 and a steady increase in stocks. Together with fluctuations in world prices, this explains the consequent decrease in tomato production (Figure 1). After further increases recorded in 2007-2009, output in Italy in 2011 returned to the level recorded in 2006.

The most recent CMO reform in fruit and vegetables introduced by Regulation (EC) No. 1182/2007 has integrated the sector into the simple payment scheme since 1st January 2008. For processing tomato, Italy opted for the three-year transition period (2008-2010) maintaining coupled payments at 50% of the national ceiling until the end of 2010. Fully decoupled payments, implemented since 2011, may partly explain the decline in tomato production. Nevertheless, thanks to the prices agreed with the processing industry, which were higher than those in the period before the reform¹, the reduction in output was not so large as it could have been.

The processing tomato is cultivated in almost all regions of Italy, but shows a high territorial concentration. Overall, nearly half of the processing tomato is produced in the South, another 44% is concentrated in the North, and only the residual 8% in the central regions. There are thus essentially two processing tomato basins accounting for over 80% of production. The southern basin comprises mainly Puglia, Campania and Basilicata and the northern basin comprises Emilia-Romagna, Lombardia, Piemonte and Veneto. Within these basins, two regions, Puglia and Emilia-Romagna, concentrate two-thirds of production. Although output has fallen over the past few years, Puglia holds top position with nearly 1.8 million tons of processing

tomato produced in 2011, or one third of the Italian output. The province of Foggia in Puglia has become the top production area in Europe, with more than 1.6 million tons of processing tomato produced in 2011 and almost twenty thousand hectares cultivated. This means that al-

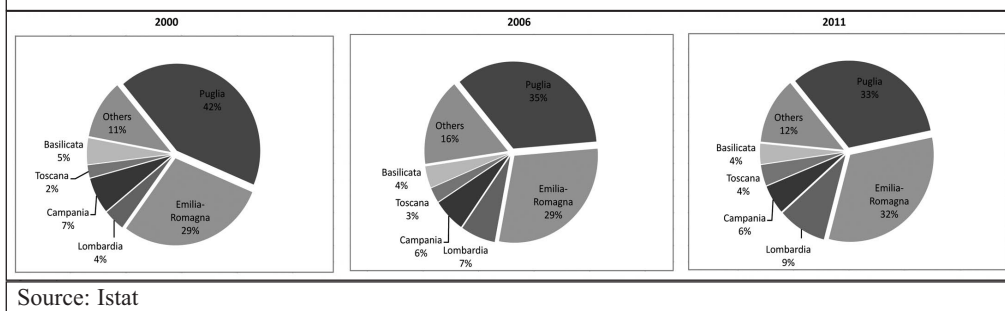
Figure 1 - Trend of surface and production - processing tomato - Italy, 2001-2011.



Source: National Unions of Italian Producer Organisations, SIAN, SOP - Pomodoro Italia website (<https://sites.google.com/site/pomodoroitalia>)

¹ For example, in northern Italy the price negotiated within the framework contract, drawn up by the representative branches of producer organizations and processing industries, was EUR 88 per ton in 2011, against EUR 49 per ton (plus a quota of EU support amounting to EUR 27.76 per ton) in 2007.

Figure 2 - Distribution of production of processing tomatoes by Region.



most two-thirds of the tomato produced in the southern basin, and 30% of the Italian output, come from the province of Foggia (Figure 2).

Output in Emilia-Romagna is only slightly lower and exceeded 1.7 million tons in 2011, a national share of 32%. The province of Piacenza in Emilia-Romagna is the second area in Italy, with an output of 700,000 tons cultivated on nearly 10,000 hectares. The output of Piacenza along with the provinces of Ferrara and Parma accounts for one fifth of Italian national output. Moreover, despite similar figures in terms of production and grown area, Emilia-Romagna exhibits a very high degree of specialisation, with almost half of the entire horticultural area covered by processing tomato. This percentage reaches 90% in the province of Parma. In Puglia the percentage does not exceed 20%; even in the province of Foggia the percentage, although higher, is only 41%.

Puglia and Emilia-Romagna, and in general the two processing tomato basins, display different characteristics as regards farm structure, production and supply chain organisation, the functioning of contractual relationships, the typology of processing tomato, etc..The northern basin is characterized by larger farms and a higher level of mechanization than the national average, while the southern basin is composed of smaller farms. A further difference is found in industrial processing: the northern area is characterized by the presence of large self-processing cooperatives, while the southern area is characterized by a high number of mostly small private companies. These differences could be due to the fact that the Northern provinces boast a long tradition in tomato production and processing, and set up the “processing tomato district”, recently converted into a “regional inter-branch organisation”.

3. Direct payments and greening in the CAP Reform Post-2013

The main strategic aims of the new CAP are sustainable food production, balanced territorial development, and enhancement of differentiation of agriculture and rural areas, the sustainable management of resources, ensuring the supply of public goods and managing the effects of climate

change. Most of the CAP Post-2013 budget will be allocated through direct payments which will continue to be the main instrument of support for EU farms. In order to make the distribution of funds equitable not only between Member States but also between regions and farms, the Commission opted for the regionalisation and internal convergence of direct payments (Euro-

pean Commission, 2011 a, b). In Italy, the redistributive effects of these measures will depend on the criteria used to define “regions”. Administrative decentralization in the agricultural sector and the management of financial resources in Italy for past rural development programmes would suggest that existing administrative regions will probably be used. It is clear however that there are other possible criteria for regionalisation including division of the country according to aspects such as altitude, agricultural potential areas, intensive/extensive areas (De Vivo *et al.*, 2012)².

According to proposal COM (2011) 625, direct payments will be divided into several components. The two main components are the basic payment, providing direct support to farmer income, and the green payment, equal to 30% of direct payments. The green component is linked to the production of public goods that the beneficiaries of direct payments are required to provide (“greening”). The European Commission has in fact emphasized the growing need for a ‘greener’ farming which guarantees the conservation of biodiversity, soil fertility and water resources and which can act as a buffering agent against climate change.

The three mandatory requirements to be met in order to receive the green payment are: crop diversification, maintenance of permanent grassland and allocation of 7% land as ecological focus areas (EFA).

Crop diversification, according to the Commission proposal, concerns arable land that covers more than three hectares, excluding land not entirely used for grass production, left fallow or cultivated with crops under water (rice). In this respect, farmers are required to grow at least three crops, each of them covering less than 70% and more than 5%. Parliament and Council proposals raise the application threshold to ten hectares. Where the arable land covers less than 30 hectares, the possibility of two crops has also been introduced, increasing the area allocable to the main crop to 75-80%. The exclusion criterion with reference to the surface for grass production, left fallow or for crops under water has been amended and has been reduced to 75% of the eligible area. The main criticism of this measure is that the simultaneous presence of three crops does not necessarily mean crop rotation. The requirement is in fact a completely inadequate approximation of crop rotation, and does not ensure agronomic and environmental improvement (De Filippis and Frascarelli, 2012).

² For further information see the following website: PAC 2014-2020. *Gli impatti regionali. Valutazioni dell'INEA* (http://www.rica.inea.it/PAC_2014_2020).

The second requirement concerns the maintenance of permanent grassland, and a limit (5%) on the conversion of grassland to arable crops. The main difference proposed by the European Parliament in Trilogue discussions concerns the maintenance of the land ratio under permanent grassland and permanent pasture compared to the total agricultural area at national, regional or sub-regional level. The Council proposal confirms the application at farm level, but proposes exceptions based on the ratio of permanent pasture to total agricultural area, and the presence of a monitoring system of permanent grassland at national, regional or appropriate sub-regional level. There are no significant changes from the previous cross-compliance requirement, which concerned the maintenance of meadows and pastures at national level (Povellato, 2012). This is thus the least restrictive of the three measures for Italian farms, and compliance should not be particularly onerous.

The third requirement proposed by the European Commission is related to the allocation of 7% of land as ecological areas, excluding areas under permanent grassland. This is the most onerous obligation for Italy, especially in specific farm contexts specialized in arable land. One of the criticisms of the measure concerns the increase of land taken out of production. Since the 2007-08 price spike and the growing realization of the fragility of global food supplies, more emphasis has been placed on the need for Europe to increase food production in the name of ‘food security’. This argument is used against the EFA proposal (Matthews, 2013). Both the European Parliament and Council propose lowering the EFA percentage to 5% (7% possibly as a result of the Commission’s evaluation report), and activation thresholds related to farm size. The Parliament and Council also suggest that the requirement needs not be applied if the majority of surface area is permanent grassland, used for the production of herbaceous forage or cultivated with crops under water. They also suggest the possibility of measuring EFA at regional level in order to obtain adjacent ecological areas. Unlike the Commission proposal, the Parliament suggests that permanent crops are not used to calculate the area earmarked for the EFA. According to the Council proposal permanent crops are part of the reference area and, in cases where the limits of trees per hectare are respected, these are considered as EFA (See Appendix).

There are also clear differences between the Commission’s proposal and Parliament and Council proposals regarding exclusion criteria. The European Commission proposed that organic farms be excluded from the greening requirements and entitled *ipso facto* to the green payment. In the amendments proposed by European Parliament (2013) and Council (2013) farms that are beneficiaries of agri-environment-climatic payments, with national or regional environmental certifications or localized in “Natura 2000” areas (only for the European Parliament) could be excluded from the greening measures.

The Assessment by the European Commission, based on

the original proposal, found that the impact of greening measures on the income of European farms is relatively low, on average € 43 per hectare of potential eligible area (European Commission, 2011b). It is, however, recognized that the cost may vary widely according to regions and farming systems, given the differences in land use and profitability as well as the specific situation of each farm (Cardillo *et al.*, 2012).

4. The PMP model

The analysis of the economic impact of the greening measures is based on a sample of 453 farms, of which 36 are processing tomato farms located in the plain of Emilia Romagna region. Data is from the Italian FADN 2011 and describes land use, yield, output prices and specific costs per activity at farm level. Data on CAP payments as well as other descriptive variables on farm status (organic or conventional) was also used in order to identify greening requirements and exclusions.

The evaluation of the effect of CAP Reform Post-2013 on processing tomato growing is carried out using a model based on Positive Mathematical Programming (PMP) (Howitt, 1995; Paris and Howitt, 1998; Paris and Arfini, 2000). In the original formula put forward by Paris and Arfini (2000), PMP was based on a three-phase procedure, summarised below:

1. Estimation of marginal costs of observed farm activities. The aim of this phase is to identify information on specific production costs which the farmer uses to formulate his production plan.

2. Estimation of a non-linear cost function. PMP estimates a quadratic cost function which represents production costs, coherent with economic theory. The method of estimation used in this phase is based on maximum entropy (Paris and Howitt, 1998).

3. Calibration of the model versus the year of observation. The observed economic production situation is reproduced using only the information on production costs established during the previous phase.

The model is thus able to simulate the effects of the main changes in agricultural policy.

An important element of innovation of the model used in this paper is the introduction of latent information into the optimization process at farm level. One of the most debated issues regarding PMP models is their supposed inability to capture farmer behavior given that certain production processes are absent in the observed situation (Röhm and Dabbert, 2003; Blanco *et al.*, 2008). Latent information is thus introduced into our model as “latent processes”. These are processes present in the sample, because at least one farm production plan includes them. But even on the farms where they are not activated, these processes can be considered as components of the production possibilities. All these elements can be captured by the model on the basis of latent cost information (Donati and Arfini, 2013). So during the simulation phase, modifications can be made to the ini-

tial production organization by including latent processes whose economic return is greater than that of other processes (Arfini and Donati, 2013).

4.1. Greening requirements in the PMP model

All the greening measures have been inserted into the PMP model through specific mathematical constraints. The optimization process can thus take account of this important component of farm choice. Below, the main greening constraints are specified.

4.1.1. Crop diversification

The three different proposals regarding crop diversification constraints are replicated in mathematical terms as follows.

European Commission

$$h_{n,s} \geq 0.05 \sum_s h_{n,s} \Leftrightarrow \left\{ \sum_s h_{n,s} > 3 \vee org_n \neq 1 \vee ecd \neq 1 \right\} \quad (1)$$

$$h_{n,s} \leq 0.7 \sum_s h_{n,s} \Leftrightarrow \left\{ \sum_s h_{n,s} > 3 \vee org_n \neq 1 \vee ecd \neq 1 \right\} \quad (2)$$

European Parliament

$$h_{n,s} \leq 0.8 \sum_s h_{n,s} \Leftrightarrow \left\{ 10 < \sum_s h_{n,s} \leq 30 \vee org_n \neq 1 \vee env_n \neq 1 \vee nat_n \neq 1 \vee epd \neq 1 \right\} \quad (3)$$

$$h_{n,s} \leq 0.75 \sum_s h_{n,s} \Leftrightarrow \left\{ \sum_s h_{n,s} > 30 \vee org_n \neq 1 \vee env_n \neq 1 \vee nat_n \neq 1 \vee epd \neq 1 \right\} \quad (4)$$

Council of the EU

$$h_{n,s} \leq 0.75 \sum_s h_{n,s} \Leftrightarrow \left\{ \sum_s h_{n,s} > 10 \vee org_n \neq 1 \vee env_n \neq 1 \vee cod1_n \neq 1 \vee cod2 \neq 1 \right\} \quad (5)$$

Where:

n : farm index;

s : arable crop index, that is a sub-index of the index j related to the whole set of activities;

$h_{n,s}$: arable crop acreage at farm level;

org_n : farm parameter, 1 for organic farms and 0 otherwise;

ecd_n : farm parameter, 1 if the arable land is entirely used for grass production, left fallow or cultivated with crops under water, and 0 otherwise.

env_n : farm parameter, 1 for beneficiary of agri-environment-climatic payments and 0 otherwise;

nat_n : farm parameter, 1 if farm situated in a Natura 2000 area and 0 otherwise;

epd_n : farm parameter, 1 where more than 75% of the eligible agricultural area is permanent grassland, permanent pasture, used for the production of grass or other forage or cultivated with crops under water, and the remaining eligible agricultural land < 50 hectares.

$cod1_n$: farm parameter, 1 if more than 75% of the eligible agricultural area is grassland or cultivated with crops under water or a combination of these;

$cod2_n$: farm parameter, 1 if more than 75% of arable land

is entirely used for production of grass or other herbaceous forage, land lying fallow, entirely cultivated with leguminous crops, or a combination of these uses.

4.1.2. Maintenance of permanent grassland

Constraints are formulated in a different way only for the exclusion of the farms entitled *ipso facto* to the greening component of direct payments.

For example, to model the European Parliament proposal, the maintenance of permanent grassland is expressed as follows:

$$h_{n,g} \geq \bar{h}_{n,g} (1 - 0.05) \Leftrightarrow \{ org_n \neq 1 \vee env_n \neq 1 \vee nat_n \neq 1 \} \quad (6)$$

Where:

g : permanent grassland index, a sub-index of the index j related to the whole set of activities;

$\bar{h}_{n,g}$: permanent grassland acreage at farm level in reference scenario (see Section 5.1).

The other symbols are used as above.

4.1.3. Ecological Focus Area (EFA)

To model the share of total farm area allocated to EFA, the land constraint is defined as follows:

$$\sum_j h_{n,j} + green_n \leq b_n \quad (7)$$

The total area of the farm is thus equal to the sum of utilized agricultural area (UAA) in the farm production system and $(\sum_j h_{n,j})$ the EFA as required by the greening actions ($green_n$).

The EFA requirement is represented in the model as follows:

European Commission

$$green_n \geq \left\{ \left[0.07 \left(\sum_r h_{n,r} - \sum_g h_{n,g} \right) \right] - \sum_f h_{n,f} \right\} \Leftrightarrow org_n \neq 1 \quad (8)$$

European Parliament

$$green_n \geq \left\{ \left[0.05 \left(\sum_r h_{n,r} - \sum_g h_{n,g} - \sum_p h_{n,p} \right) \right] - \sum_f h_{n,f} \right\} \Leftrightarrow \left\{ \sum_s h_{n,s} > 10 \vee org_n \neq 1 \vee env_n \neq 1 \vee nat_n \neq 1 \vee epd_n \neq 1 \right\} \quad (9)$$

Council of the EU

$$green_n \geq \left\{ \left[0.05 \left(\sum_r h_{n,r} - \sum_g h_{n,g} \right) \right] - \left(\sum_p h_{n,p} + \sum_f h_{n,f} \right) \right\} \Leftrightarrow \left\{ \left(\sum_r \bar{h}_{n,r} - \sum_g \bar{h}_{n,g} \right) > 15 \right. \\ \left. \vee org_n \neq 1 \vee env_n \neq 1 \vee cod1_n \neq 1 \vee cod2 \neq 1 \right\} \quad (10)$$

Where:

r : eligible crop index, that is a sub-index of the index j related to the whole set of activities.

f : land left fallow index, that is a sub-index of the index j related to the whole set of activities.

p : permanent crop index, that is a sub-index of the index j related to the whole set of activities.

The other symbols are used as above.

4.2. Direct payments in the PMP model

As well as the impact of greening, the model also evaluates the impact of variation in direct payments. Direct payments were calculated taking into account the lower ceiling for Italy, regionalisation and the process of internal conver-

gence (COM (2011) 625). This paper considers Italian administrative regions as units of regionalisation. It is assumed that the redistribution will take into account the level of payments received in the past, so the lowering of the ceiling for Emilia Romagna follows the lowering for Italy as a whole: -2.6% in 2014 and -10.3% in 2019 compared to the baseline (INEA, 2013). In the model, the ceiling is divided into two components (basic payment scheme -70% and green payment -30%). Nowadays it is not possible to identify other minor components at national or regional level.

In the European Commission proposal, the unit value of payment entitlements is calculated as a flat rate consisting of a basic payment (212.5 €/ha) and a greening component (91.1 €/ha), for a total payment per hectare of 303.6 €/ha.

In order to mitigate the reduction of payment entitlements proposed by the European Commission, the Parliament and Council proposed derogations from uniform distribution per hectare. These scenarios introduce convergence mechanisms for the basic payment scheme, but assume the same value of the green component for all farms in the region (91.1 €/ha).

For the Parliament scenario, the unit value of payment entitlements in 2014 was calculated by applying a convergence process on 10% of the regional ceiling. Then a convergence of 2014 value toward the regional unit value in 2019 was applied, fixing a maximum decrease of the initial unit value of 30%.

For the Council scenario, the payment per hectare at farm level in 2014 was calculated by applying a linear reduction on the 2013 unit value, according to the ceiling reduction of the basic payment for 2014. The unit value of payment entitlements whose 2014 unit value was lower than 90 % of the regional unit value in 2019 was increased by one third of the difference between their initial unit value and 90 % of the regional unit value in 2019. In order to finance this convergence, a reduction of payment entitlements with a value above the 2019 average was applied.

In all scenarios a progressive reduction (capping) in payments for amounts exceeding €150,000 up to the maximum threshold of €300,000 was applied.

5. Potential impact of the CAP reform

5.1. Policy scenarios

The following scenarios were analyzed:

- Reference scenario (SIM_1). This scenario reproduces the situation observed in 2011, after the Health Check which completes the direct payments decoupling and updates the modulation.
- CAP Reform - European Commission proposals (SIM_EC). This scenario models EC capping and the greening constraints. The unit value of payment entitlements is calculated as a flat rate, as described in Section 4.2.

- CAP Reform - European Parliament proposals (SIM_EP). This scenario models EP capping and greening constraints. The unit value of payment entitlements is differentiated by farm, and the convergence mechanism described in Section 4.2 is applied.

- CAP Reform - Council of the EU proposals (SIM_CO). This scenario implements Council of the EU capping and greening constraints. The unit value of payment entitlements is differentiated by farm, and the convergence mechanism described in Section 4.2 is applied.

The results of simulations are reported below and show effects of the proposals on land use and economic outcomes. In order to analyze the impact of the reform on the tomato sector compared to other sectors, results are shown for processing tomato farms and for farming as a whole.

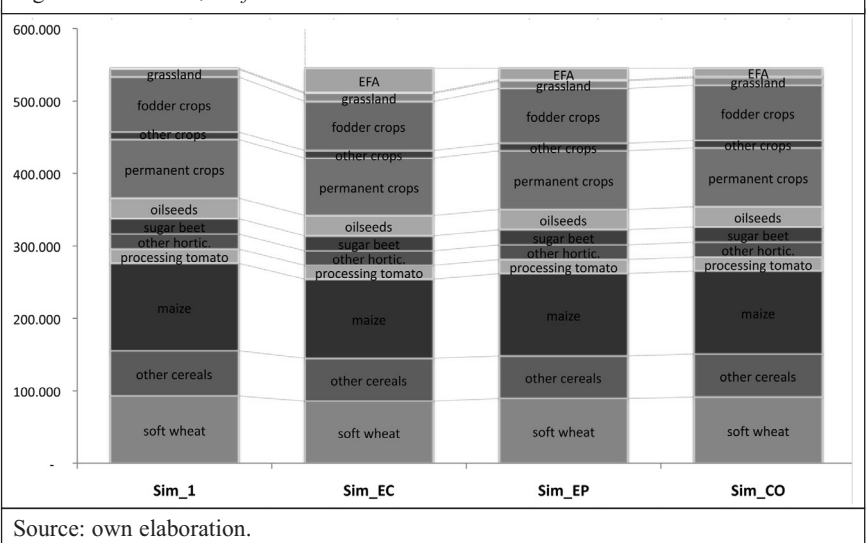
5.2. Land allocation

5.2.1. All farms

The simulations show that greening requirements have quite a significant impact on cereal crops. There is a relevant decrease for all cereals except for durum wheat. This effect can also be attributed to the requirement for diversification, which particularly in Commission proposals obliges specialized farms to increase (or activate) other crops. These crops are however affected by EFA quotas; in many cases farms opt for cereal area as EFA in order to retain other more profitable crops such as processing tomato. Alfalfa and maize, important crops in the area, also show a significant reduction with part of their area moving to other crops, in particular protein crops, and to permanent grassland.

In the Parliament and Council scenarios, the impact is clearly much more limited. This is partly due to new main crop and EFA thresholds, but mainly to the increase in the number of farms excluded from greening requirements. The percentage of EFA is 6.1% in the Commission scenario and just 2.9% (Sim_EP) and 2.1% (Sim_CO) in the other two.

Figure 3 - Land use, all farms.



Crops	(Ha)				var. % compared to Sim_1		
	Sim_1	Sim_EC	Sim_EP	Sim_CO	Sim_EC	Sim_EP	Sim_CO
durum wheat	4.467	4.106	4.230	4.241	-8,1	-5,3	-5,1
soft wheat	8.930	7.383	8.062	8.209	-17,3	-9,7	-8,1
barley	92	82	88	91	-10,7	-4,5	-1,4
maize	13.157	11.885	12.487	12.628	-9,7	-5,1	-4,0
rice	2.152	2.133	2.141	2.143	-0,8	-0,5	-0,4
other cereals	597	541	550	562	-9,4	-7,8	-5,8
onion	373	369	371	371	-1,1	-0,6	-0,4
carrot	1.369	1.367	1.368	1.369	-0,2	-0,1	0,0
potato	1.606	1.597	1.600	1.601	-0,6	-0,4	-0,3
processing tomato	19.546	19.199	19.309	19.328	-1,8	-1,2	-1,1
other hort.	4.078	3.792	3.896	3.926	-7,0	-4,5	-3,7
Sugarbeet	1.570	1.517	1.546	1.547	-3,4	-1,5	-1,5
oilseeds	929	868	889	897	-6,5	-4,3	-3,4
permanent crops	1.472	1.472	1.472	1.472	0,0	0,0	0,0
silage	1.850	1.759	1.783	1.784	-5,0	-3,6	-3,6
alfalfa	3.268	2.988	3.071	3.090	-8,6	-6,0	-5,5
other crops	2.954	2.958	2.957	2.957	0,1	0,1	0,1
grassland	368	386	386	386	5,0	5,0	5,0
left fallow	108	108	108	108	0,0	0,0	0,0
EFA		4.376	2.574	2.177	6,4	(% of UAA) 3,7	3,2
Total UAA	68.885	68.885	68.885	68.885			

Source: own elaboration.

5.2.2. Processing tomato farms

Table 1 shows changes in the production plan of tomato farms. The overall contraction of the processing tomato surface is limited in all three scenarios. It is mainly due to the diversification requirement, activated only for those few farms in the sample with a very high production specialization. On many farms, tomato is associated with other crops, mainly maize and wheat. In line with the overall situation, cereal crops and maize reduce their surface for the EFA in tomato farms too, as shown by the sharp surface reduction of these crops in all scenarios.

In the Commission scenario, the high share of EFA (6.4%) on tomato processing farms is due to the exclusion of the only organic farms and to permanent crops not considered as EFA (Table 1). In other scenarios (with EFA set at 5%) this quota is reduced to 3.7% (Sim_EP) and under 3.2% (Sim_CO). The increase of the application threshold does not produce significant changes in the tomato sector, where large farms often exceed it. The presence of permanent crops impacts on the share of EFA, and consequently on the production plan, according to the different exclusion criteria for these crops. As in the other

sectors, the Council scenario shows smaller changes in the production plan for processing tomato farms.

5.3. Economic outcomes

The effects of the different CAP proposals on the incomes of Emilia-Romagna producers were evaluated with reference to the farm gross margin calculated at two different levels. The first level gross margin (GM I) is the difference between the gross saleable production and specific costs of production. The second level gross margin (GM II) also includes direct payments (basic + green payments). The first level shows more clearly the net effect of greening measures on farms, while the second shows the overall economic impact.

5.3.1. All farms

Greening applied as in Commission proposals would lower GM I by 5%, with a reduction of gross saleable production (GSP) and variable costs (VC) of around 6%

(Table 2). The average value of the GM I is 1,396 €/ha, so this proposal would lead to an average loss of about 70 €/ha. This reduction is significant partly because permanent crops with high profitability would be affected by the EFA requirement. For arable farms, the impact of greening on gross margin is an average loss of about 55 €/ha.

The attenuation of greening requirements proposed by Parliament and Council, with a big increase in the number of exempted farms, considerably reduces their impact. GM I reductions are 1.7% (SIM_EP) and 1.2% (SIM_CO). Assuming a payment per hectare of around € 90, it would appear that green payments compensate for lower profits in the Emilia Romagna plain.

The reduction of direct payments leads however to a further decrease in farm profitability. In the Commission scenario, the reduction of GM II is 8.1% but in the Parliament

	Sim_1	Sim_EC	Sim_EP	Sim_CO	Var. % compared to Sim_1		
	(Euro/ha)	(Euro/ha)			Sim_EC	Sim_EP	Sim_CO
GSP	3.326	3.144	3.272	3.287	-5,5	-1,6	-1,2
VC	1.930	1.817	1.900	1.907	-5,8	-1,6	-1,2
GM I LEVEL	1.396	1.326	1.373	1.380	-5,0	-1,7	-1,2
Subsidies	377,3	303,6	318,3	323,0	-19,5	-15,6	-14,4
GM II LEVEL	1.773	1.630	1.691	1.703	-8,1	-4,6	-4,0

Source: own elaboration.

Table 3 - Dynamics in the main economic variables, processing tomato farms.

	Sim_1	Sim_EC	Sim_EP	Sim_CO	Sim_EC	Sim_EP	Sim_CO
	(Euro/ha)	(Euro/ha)			Var. % compared to Sim_1		
GSP	4.467	4.328	4.381	4.392	-3,1	-1,9	-1,7
VC	3.232	3.141	3.174	3.180	-2,8	-1,8	-1,6
GM I LEVEL	1.235	1.188	1.207	1.212	-3,9	-2,3	-1,9
Subsidies	775,8	303,6	464,7	489,6	-60,9	-40,1	-36,9
GM II LEVEL	2.011	1.491	1.672	1.702	-25,8	-16,9	-15,4

Source: own elaboration.

and Council scenarios (SIM_EP and SIM_CO), which include limitations on payment reductions, the decrease in gross margin is below 5%. So for direct payments, like greening requirements, Council proposals (-14.4% of payments) are less harsh than Parliament proposals.

5.3.2. The processing tomato sector

The impact of greening on processing tomato farms is lower than the impact on agriculture as a whole, but in line with the impact observed on other arable farms. Profit levels are currently significantly higher than for the other arable farms, and would fall by 3.9%, or 47 €/ha, as a consequence of greening in GM I in the Commission scenario. In the Parliament and Council scenarios, new environmental constraints would lead to a reduction in profits of about 25 €/ha (Table 3). In all three scenarios, green payments appear to compensate for lower profits.

The impact of the direct payment convergence is higher in processing tomato than in agriculture as a whole. Historically, tomato farms have received average higher payments than other sectors. In fact in the sample, the average payment per hectare is about 775 €/ha, more than twice the average of other farms, and the GM II exceeds 2,000 €/ha, compared to 1,773 €/ha in other sectors. The flat rate reduction proposed by the Commission (Sim_EC) would reduce payments by more than 60%, leading to an overall contraction of 26% for the tomato farm income. In Parliament and Council scenarios there is still a large reduction, although it is slightly less harsh. The average payments reduce to 465-490 €/ha, corresponding to a decrease of more than 35%. The overall average profit levels of processing tomato farms would thus decrease by 15-17% compared to the reference scenario, which means a reduction four times higher than other farms.

5.4. Discussion of results

The PMP model results show that the processing tomato sector will be affected in terms of farm economic performance rather than in production plans. There are two distinct effects, one produced by greening measures, and one generated by the process of payment convergence introduced by the regionalisation objective.

With regard to greening measures, the model shows that both diversification and EFA could substantially affect farm

income. The impact of these requirements on processing tomato farms does not appear to differ greatly from other arable farms. The Commission proposal for greening would lead to an average gross margin reduction of about 50 €/ha both in the tomato sector and on other arable farms. For tomato farms, the EFA requirement has a bigger impact on the gross margin than crop diversification. Most of the tomato farms in the sample already have a diversified production plan, where other crops (mainly maize and wheat) can be converted to EFA. So the new greening requirements have a small impact on land use in processing tomato areas, lowering it by an average of 2%. The attenuation of the greening requirements proposed by the Parliament and the Council mitigate changes in production plan mainly because a higher number of farms are excluded from the new constraints.

Convergence of direct payments on the other hand has very different impacts on the processing tomato and the other sectors. Considering all farms in the sample, payments would be reduced by between 19.5% (Commission scenario) and by 14.4% if the Council convergence mechanism were applied. This would result in an average reduction of the gross margin of 8% if a flat rate were applied. There would be a reduction under 5% in the other scenarios. The impact is significantly higher for the processing tomato sector, where farms have historically received high payments linked to production. For these farms, a uniform distribution of payments per hectare would mean a reduction of over 60% of the entitlement unit value. The convergence mechanisms proposed by the Parliament, and especially by the Council, partially mitigate this reduction, but it remains big at -40%. CAP reform thus has a bigger impact on profit levels of processing tomato farms than other sectors. The processing tomato farms would lose a quarter of their income in the Commission scenario and more than 15% in the other two scenarios. Although other convergence mechanisms for direct payment could mitigate the impact of the reform, it is certain that there will be a reduction in their profitability. In order to ensure the current production basin maintenance, part of this reduction could be covered by a higher price to be paid by the processing industries, as it occurred with the introduction of decoupling.

6. Conclusions

CAP reform introduces two key measures that could significantly affect farm profit levels: greening and convergence of direct payments. The Commission greening proposal includes three requirements linked to green pay-

ments: crop diversification, the maintenance of permanent grassland and the establishment of ecological focus areas. The payment convergence process implies that individual farm payments in a given region will progressively approach the same average single payment. Both the greening measures and payment convergence will have a significant impact on farm decisions and on economic performance.

This study uses a model based on PMP methodology, reproducing specific greening requirements and the new distribution of direct payments, in order to compare and evaluate proposals by the European Commission, the European Parliament and the Council of the EU. The analysis is carried out on an FADN sample of farms located in the plain of Emilia Romagna and focuses on the processing tomato sector.

The results show that the tomato sector is less sensitive to the greening measures and much more affected by the regionalisation and the convergence process. The EFA measure is the biggest constraint for the tomato farms. In order to meet this requirement, tomato farms reduce mainly their cereal surface, in particular soft wheat and maize. Tomato production is partially affected by the reduction of cereals because of rotational constraints and the complementary relationship captured by the PMP model (Paris and Howitt, 1998). The other greening requirements are all substantially met by almost all tomato farms in the sample. Tomato farms are in fact characterized by a diversified production plan and by a moderate average farm size. In terms of economic performance, greening in all three scenarios leads to a reduction in the first level of gross margin which is lower than 4%. This reduction is not a cause for concern if compared to dynamics in the second level gross margin which measures overall impact of the reform taking into account variation in farm payments. Payment convergence measures lead to a big fall in profits in tomato farms which reach -26%, -17% and -15% in Commission, Parliament and Council scenarios respectively. It is widely recognized that the tomato sector has been one of the sectors that has traditionally received higher subsidies than most other agricultural sectors. The new CAP reform can reduce the profitability of the sector with some foreseeable concerns for the farmers and for processing tomato industry. Tomato processing firms should consider possible strategies to face this important economic change in the sector.

We believe that this study is innovative because, to our knowledge, it is the first to compare the economic and production effects of the Trilogue proposals at territorial level. It is nevertheless subject to certain limitations. First of all, the entire analysis focuses on the three institutional proposals, neglecting to consider the most likely reform option, still under discussion at the time of writing, although a political agreement has been overtaken. However, this paper aims to assess the differences and the effects of the three proposals discussed in the technical and political process that will lead to the final document of

the 2014-2020 CAP. Secondly, the model assumes that market prices are stable and not affected by modifications. Likely variations in the commodity market prices can modify the strategies of processing tomato producers and induce different production decisions. Finally, the model focuses on the agricultural phase without considering the downstream supply chain. A study of strategies which processing industries could use to face the new market and policy scenarios would be an interesting development of the model.

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Appendix. The greening according to the European Commission, the European Parliament and the Council of the EU.

Table A1 – Detail of the greening conditions according to Commission, Parliament and Council of the EU proposals.

Measure	European Commission	European Parliament (March 2013)	Council of EU (March 2013)
1. Diversification (arable land)	> 3 ha: 3 crops	10-30 ha: 2 crops > 30 ha: 3 crops	10-30 ha: 2 crops > 30 ha: 3 crops
Limits for crops	> 5% and < 70%	2 crops: < 80% (main crop) 3 crops: < 75% (main crop) and < 95% (2 main crops)	2 crops: < 75% (main crop) 3 crops: < 75% (main crop) and < 95% (2 main crops)
Exception	entirely used for grass production, left fallow or crops under water	if > 75% permanent grassland or permanent pasture or used for the production of grass of other forage or cultivated with crops under water and the remaining eligible agricultural land < 50 ha	- if > 75% (eligible agricultural area) is grassland or cultivated with crops under water - if > 75% (arable land) for production of grass or other herbaceous forage, land laying fallow or entirely cultivated with leguminous crops
2. Permanent grassland	Maintenance of permanent grassland and permanent pasture	Maintenance of the ratio of the land under permanent grassland and permanent pasture to total agricultural area	Maintenance of permanent grassland and permanent pasture
Maximum conversion	5%	5% (with exception of carbon rich soils, wetlands and semi natural grassland and pastures)	5%
Application level	farm level	national, regional or sub-regional level	farm level, with derogations based on the ratio of permanent grassland/agricultural area and monitoring system of permanent grassland
3. Ecological focus area	7%	-3% - 5% from 2016 - 7% (if appropriate) from 2018 (evaluation report of Commission)	-5% - 7% (if appropriate) from 2018 (evaluation report of Commission)
Excluded area	Permanent grassland/pasture	Permanent grassland/pasture and permanent crops	Permanent grassland/pasture
Mandatory	all farms	> 10 ha (arable land)	> 15 ha (eligible agricultural area excluding areas under permanent grassland/pasture)
Exception		if > 75% permanent grassland or permanent pasture of used for the production of grass or other forage or cultivated with crops under water and remaining eligible agricultural land < 50 ha	- if > 75% (eligible agricultural area) is grassland or cultivated with crops under water - if > 75% (arable land) for production of grass or other herbaceous forage, land laying fallow or entirely cultivated with leguminous crops
Biodiversity corridors (optional derogation, MS)		from 2016, up to 3% at a regional level in order to obtain adjacent ecological areas	- up to 50% of the percentage points of the ecological focus area at a regional level in order to obtain adjacent ecological areas - collective implementation for farmers whose holdings are in close proximity
EFA	- land left fallow - terraces - landscape features - buffer strips - afforested areas	- land left fallow - terraces - landscape features - buffer strips - afforested areas - land planted with nitrogen-fixing crops	- areas of permanent crops (20-250 trees per ha) - permanent crops on sloping land - buffer strips without fertilization and pesticides - hectares of agro-forestry - areas with short rotation coppice - areas with catch crops or green cover - areas with nitrogen-fixing crops - land left fallow, terraces, landscape features, afforested areas
Potential crops on EFA		production without utilization of pesticide or fertilizer application	
Entitled IPSO FACTO to the greening component	organic farms	- organic farms - beneficiaries of agri-environmental-climatic payments - national or regional environmental certification schemes - Natura 2000 areas	- organic farms - beneficiaries of agri-environmental-climatic payments - national or regional environmental certification schemes

Source: own elaboration on Commission proposal (COM 2011 (625)) and amendments proposed by EP (2013) and Council of the EU (2013).